DIGITAL ELEVATION MODELS OF THE WESTERN VALLES MARINERIS, MARS E. Hauber, B. Giese and A.C. Cook, DLR Institute of Planetary Exploration, Rudower Chaussee 5, D-12489 Berlin, Germany (Email: Ernst.Hauber@dlr.de).

INTRODUCTION

The canyon system of the Valles Marineris is one of the most striking large-scale features of the martian surface. Different mechanisms such as deep-seated tension fracturing [1] or localized crustal rifting [2,3] have been proposed to explain the development of the troughs. An overview of the structure and history of the Valles Marineris can be found in [4]. Recent work analyzing the canyon´s tectonic [5,6,7,8,9] and erosional and sedimentational history [10] all relied on topographic data. In other regions on Mars, similar studies also involved the knowledge of topography [11,12,13]. Thus, detailed topographic measurements will enable a more precise evaluation of these and related problems.

However, reliable Digital Elevation Models (DEMs) are still rare in planetary science at regional and global scales. The goal of our study is to derive regional high-resolution Digital Elevation Models (DEM) of the western part of the Valles Marineris on Mars using state-of-the-art digital image matching techniques.

STUDY AREA AND DATA SET

The study area is located roughly between 76°W-96°W and 2°S-10°S, respectively. Contiguous stereo coverage of the study area is provided by nadir-looking images and slightly oblique-looking images with spatial resolutions of 70-130m/pixel [14]. All images were taken through the clear filter and have nearly identical illumination. As a base map for geological mapping, high-resolution (1024pixel/°) image mosaics have been prepared from both the nadir (Fig. 1) and the oblique-looking images as well as from even higher-resolution images taken late in the Viking Orbiter mission.

APPROACH

In a pilot study we derived local DEM´s in two areas (see Fig. 1) using a technique described in [15] and applied previously to Viking Orbiter images [e.g. 16]. Digital image correlation was applied to images geometrically corrected for vidicon distortions to find a dense grid of tiepoints, and orbit and camera pointing data [17,18] were used to calculate ground coordinates of object points.

In a more advanced method [19, 20, 21] we will apply a rigorous photogrammetric analysis to the selected areas which are then extended to finally derive a DEM of the whole area shown in Fig. 1. Digital image matching techniques will be used to find tiepoints in the raw images rather than in images corrected for vidicon distortions, and a photogrammetric bundle block adjustment will be applied to further improve the camera pointing data [22]. Object point coordinates are calculated by photogrammetric forward intersection taking into account the camera distortion derived from the location of the reseaus.

RESULTS

First results from our pilot study are given in Fig. 2 and 3. They were generated using one stereo pair for each DEM and show considerable detail both in lateral and vertical direction. They suggest that further studies of this area are well warranted and feasible.

REFERENCES

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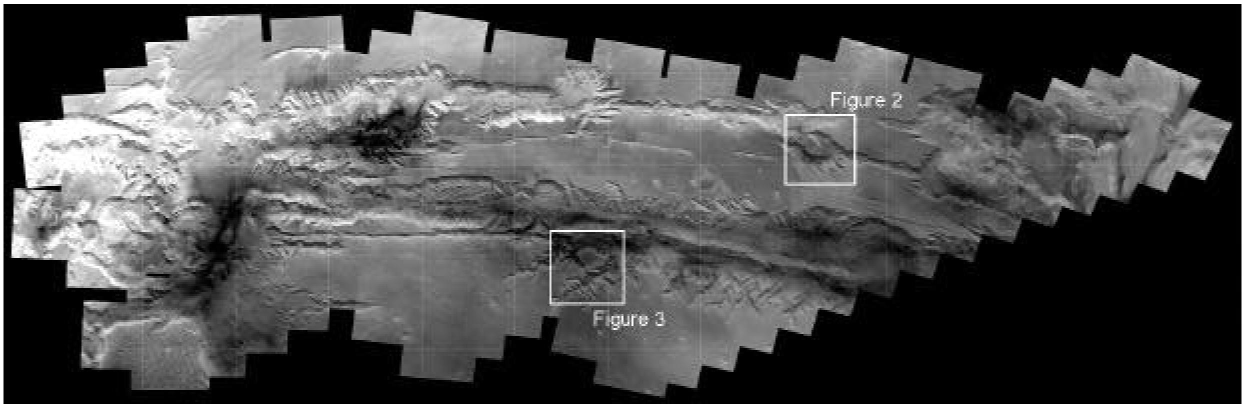
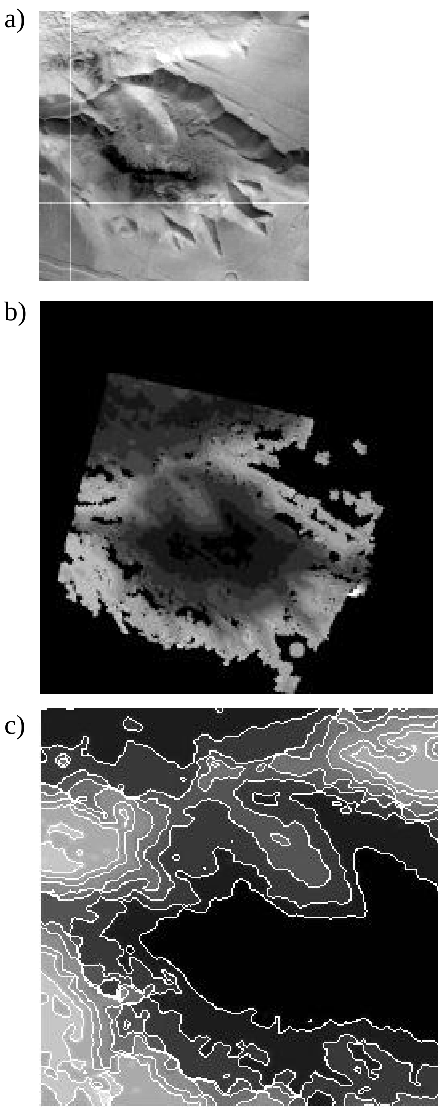
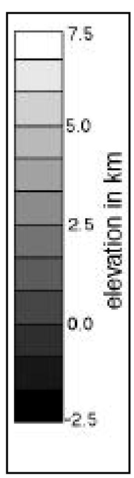


Figure 1: Digital mosaic of nadir-looking Viking Orbiter images used for DEM production. Longitude range is from 70.5°W to 97°W, latitude range is from -11.5°S to -2.5°S (Mercator projection, grid spacing 2x2°). Solid white boxes outline DEM examples of Figures 2 and 3, respectively.





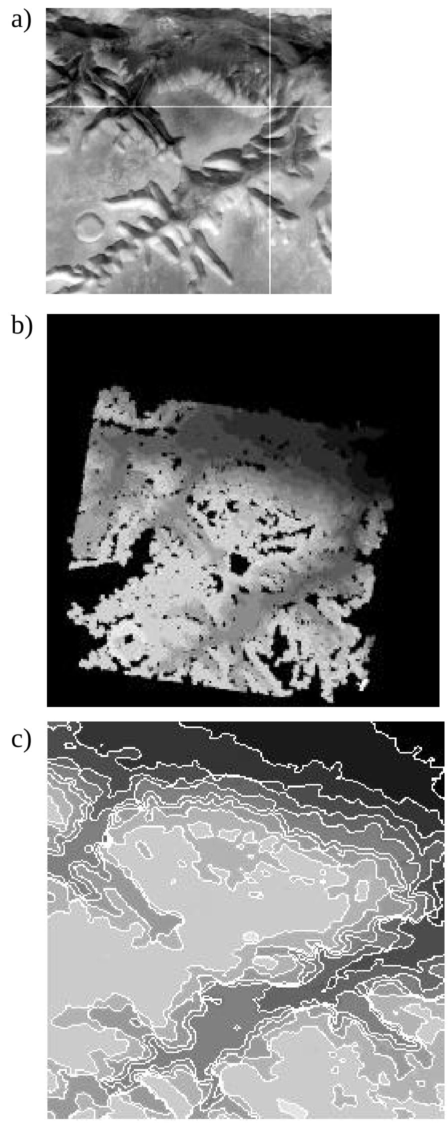


Figure 2: Preliminary DEM of part of Tithonium Chasma: a) Detail (see Fig. 1), b) DEM (black areas indicate missing data), c) contoured DEM (missing data filled by interpolation). Figures 2a-c are not to scale!

Figure 3: Preliminary DEM of part of Ius Chasma: a) Detail (see Fig. 1), b) DEM (black areas indicate missing data), c) contoured DEM (missing data filled by interpolation). Figures 3a-c are not to scale!